

AMATEUR SATELLITE REPORT

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Satellite Technical Meeting Reported

A Special Report to ASR by W3GEY and DJ4ZC

A meeting of many of the national groups interested in the construction of amateur satellites was held during the period June 30 through July 3 at Hotel de la Bere in the vicinity of Cheltenham, England. In attendance were the following invited representatives: Ian Ashley ZL1AOX, Dick Daniels W4PUJ, Robin Gape G8DQX, Bandi Gschwindt HA5WH, Werner Haas DJ5KQ, Gordon Hardman KE3D, Phil Karn KA9Q, Jan King W3GEY, HansPeter Kuhlen DK1YQ, Karl Meinzer DJ4ZC, Harold Price NK6K, Randy Smith VE1SAT/VE6, Martin Sweeting G3YJO and Dave Woodhall ZS6BNT. Not in attendance were invited representatives from the technical groups of JAMSAT and RACE.

On the agenda were the following main items:

- 1) Review of AO-10 performance and future scheduling of spacecraft operations.
- 2) Review of the PACSAT mission.
- 3) Review of the UO-11 spacecraft status.
- 4) Review of the Ariane-4 launch opportunity.
- 5) Review of new technologies required for future amateur satellites.

Due to the final orbit obtained by AO-10, a set of operating procedures were required that would deal with the upcoming eclipse and sun angle constraints expected over the next two year period. The schedule selected is responsive to the reduced power per orbit and the requirement to off-point the satellite from its optimum attitude in order to minimize thermal and power effects caused by poor sun angles. At the same time attempts were made to respond to a variety of user operating requests.

A modified general beacon (145.810 MHz) schedule was also adopted that more equally shares time between Morse code, 50 baud RTTY and 400 BPS PSK telemetry and reduces the time between successive transmissions of any type.

The details of these schedules will be announced by usual amateur satellite society sources within the next few weeks. They will be in effect by early August as this is the time required to finalize the spacecraft maneuver and implement the needed software.

Regarding future changes to the satellite's schedule, the amateur satellite technical group present adopted the following proposal for review and adoption by the world wide amateur satellite societies:

Proposal

For the Formation of an International Amateur Satellite Service Coordination Committee.

This group, recognizing that:

- 1) The launch of a satellite system represents the creation of a significant resource for the use of all radio amateurs;
- 2) The mission requirements of the groups providing a new satellite system are of primary importance;
- 3) The operational aspects of the amateur satellite service must be carefully identified, planned and managed; and
- 4) The freedom of the individual national and international groups to negotiate and plan new missions independent of external constraints must be maintained,

Proposes the formation of an international amateur satellite service coordinating committee, whose mandate shall be to:

- 1) Establish technical and operational standards for the amateur satellite service;
- 2) Plan and coordinate the orbital operations of each portion of a system which may be released by the groups which launched the system; and
- 3) Interface with the International Amateur Radio Union to ensure that the best interests of all radio amateurs are given due consideration in this planning process,

And further proposes that:

Membership in this committee be limited to those groups who have as a primary interest the provision and utilization of amateur satellite services, as evidenced by their charters or constitutions, and to such further groups as the committee shall determine advisable. (End of Proposal)

No decisions regarding PACSAT were taken by the assembled group. Considerable discussion was held con-

cerning the need for coordination of packet radio standards world wide. Considerable concern was raised that the JAS-1 packet experiment is unlikely to be compatible with the PACSAT standards on the basis of data rate and modulation type. In general, it was felt that more work was necessary to adopt true international standards for this mode of communications.

No decisions regarding UO-11 were taken by the assembled group. M. Sweeting reported that the spacecraft would be put into service and the experiment program initiated as soon as the boom deployment was complete which was expected in approximately two weeks time. (Boom was deployed successfully 24 July.—Ed.)

The Ariane-4 launch opportunity was reviewed. ESA has offered AMSAT-DL a firm launch contract for 290,000 European Accounting Units on the Ariane-4 test Launch. The contract is expected to be signed in late July.

Three candidate missions were discussed. These included an Astroid encounter probe, an advanced Phase IV satellite system concept and a modified Phase III satellite. The first two candidates were given lower possibility of success due to time and fiscal constraints. This is particularly true due to the high launch cost being imposed by ESA on this launch. The Asteriod encounter probe was not discussed further. The Phase IV concept presented by W3GEY was given serious consideration for future opportunities and W3GEY, DJ4ZC and G3YJO will continue to discuss and define this concept.

The Phase IIIC satellite to be incorporated on Ariane-4 will contain all of the hardware included aboard AO-10 but with the following additions or modifications:

- 1) A modified kick motor using a plasma propulsion technology.
- 2) A modified Mode-L transponder with improved efficiency.
- 3) An S-Band beacon experiment.
- 4) A packet radio and beacon unit.

The later unit will be a store-and-forward device with approximately 1 megabyte of memory. In addition, it may have a mode of operation allowing straight regeneration of data as would be of use by gateway nodes internationally. The same unit will be capable of using the large memory for storage of beacon messages which will be transmitted in 300 or 1200 bps FSK or PSK. The packet mode is expected to use 2400 bps PSK.

The Phase IIIC satellite will be constructed by all of the groups attending the meeting. Work assignments were made so that progress on the new satellite may begin immediately.

A variety of spacecraft technologies were discussed during the last day of the conference. The intent was to identify technologies needed for future amateur satellite missions. Included in the presentations were propulsion technologies, attitude control technologies and improvements in ranging/orbit determination technology.

It was felt by most of the participants that the meeting accomplished its intended objectives and was much needed. The conference again demonstrated the value of international cooperation and participation as the amateur satellite service matures.

RSGB/AMSAT UK Bulletins On AO-10 Scheduled

The bulletins broadcast by AMSAT UK originate from taped text compiled from news input to the Radio Society of Great Britain (RSGB) and AMSAT UK. All broadcasts are on AO-10 Special Service Channel (SSC) H2 with a downlink frequency of 145.962 MHz. The bulletins are broadcast during IARU Region 1 convenient hours, i.e., they are optimized for Europe and Africa.

It should be noted that under the BROADCAST license issued GB3RS/GB2AUK by the Dept. of Trade and Industry, no two-way communication is permitted by the news broadcaster. However, after the broadcast is complete, clear and precise reporting of reception is solicited. Stations should call 10 kHz down, i.e., approximately 145.950 to .952 kHz from the H2 SSC.

Any radio amateur or AMSAT group wishing to input news items of interest to Region 1 members or other AMSAT UK groups should send the information in English to RSGB-HQ or AMSAT UK before the Thursday prior to the Sunday bulletin.

G3AAJ — Region 1 AMSAT SSC Coordinator

Dates and Times With Pointing Angles For 51N, O W

Date	Time	Range (km)	Elevation	Azimuth
12 Aug	1830	38288	29	98
26 Aug	2030	36398	53	149
12 Sep	1600	39874	14	82
16 Sep	1800	37359	41	121
23 Sep		(None)	(Sub-horizon)	
30 Sep	2030	36792	52	193
07 Oct	1500	38341	26	98
14 Oct		(None)		
21 Oct	1730	36875	49	153
28 Oct	1230	40075	10	83
04 Nov	2000	37544	41	225
11 Nov	1500	37812	37	122
18 Nov		(None)		
25 Nov	1700	37197	47	190
02 Dec	1130	38336	22	100
09 Dec	1930	38908	25	247
16 Dec	1400	37006	44	153
23 Dec	0930	40680	7	92
30 Dec	1630	37856	36	221

Project OSCAR Calendars Spur Big Donation

Project OSCAR, Inc. recently announced the sale of Orbital Calendars has once again been a successful fund raiser. In addition to the proceeds of the sale of these Calendars which are sold by AMSAT at various hamfests and conventions, a check for \$1,000 has been sent to AMSAT. Project OSCAR has sent these monies to be used as AMSAT's Officers decide best serves the Amateur Satellite Community in furthering the Amateur Satellite Program. Congratulations to all who helped make the Calendar a success again this year! AMSAT sincerely thanks all Project OSCAR members for their continued high level of support!

New Area Coordinators Announced

Chief Area Coordinator Jim McKim, W0CY, has announced the recent appointment of three additional Area Coordinators. They are:

Don E. Knollinger, WB8ZTV, Moundsville, WV; Bruce Power, WD4HWO, Tallahassee, FL; and Stephen Peterson, K17L, Salt Lake City, UT.

AMSAT heartily congratulates the new appointees and wishes them well as they take up their new duties in helping others get aboard the AMSAT bandwagon.

UO-11 Boom Deployed

An historic milestone on the UoSAT-OSCAR 11 "Comeback Trail" was marked recently with the successful deployment of the gravity gradient boom of UO-11. The following report was filed recently by UoSAT Programme Manager Martin Sweeting, G3YJO, at the University of Surrey.

UoSAT Bulletin-85 27th July 1984

UoSAT-OSCAR 11 Gravity Gradient Boom Deployment

Following several days final preparation and rehearsals, the UO-11 gravity gradient boom was deployed under on-board 1802 computer control at 10:35 gmt during orbit 2113 on the 24th July.

The automatic magnetorquing manoeuvres, continuously executed by the 1802 over the last few weeks, had aligned the spacecraft closely to the geomagnetic field vector and reduced residual motions (wobble) to a very low value. Following final confirmation of auspicious deployment conditions at AOS at Surrey on orbit 2113, the 1802 was given instructions to terminate the magnetorquing routines and deploy the boom for 15 minutes taking the spacecraft out of range of UoS. Spacecraft telemetry indicated reasonable boom motor current and correct operation of the 1802. The 1802 simultaneously recorded X,Y,Z, +5V current and boom & computer status channels automatically throughout the operation while the boom was being deployed and during the following orbit, to monitor gravity gradient capture and spacecraft operations.

The stored data was dumped at UoS on the next orbit (2114) and examination confirmed the correct operation of the deployment routine and preliminary analysis of the stored Navigation Magnetometer data indicated successful gravity gradient capture.

Gravity capture could, however, occur successfully WITHOUT correct boom extension due to the excellent initial controlled attitude of the spacecraft reliant solely on the asymmetric body shape — any residual energy and the effect of perturbing forces, however, would be likely to cause this condition to deteriorate quite rapidly if the boom had not deployed to a significant extent.

Data gathered over the following days confirmed, however, that the spacecraft maintained successful gravity gradient stabilisation and showed no evidence of severe libration.

The most obvious effect of gravity gradient capture is that the spacecraft will now maintain the communication antennas and camera pointing at the earth. Residual energy before boom deployment will translate itself into subsequent libration after GG-lock which will be monitored and minimised using magnetorquing routines similar to those used during initial attitude control manoeuvres. The digital sun and earth horizon sensors will now be activated to determine the spacecraft's attitude and degree of libration.

Once the spacecraft GG attitude behaviour has been analysed, it is probable that the spacecraft will be spun very slowly around the Z-axis in order to improve the internal temperatures — currently running somewhat cool. Introducing a very slow Z-spin does, of course, interact with the GG stabilising forces but only to impart a small forward or backward 'tilt' of a few degrees dependent on spin rate.

Gravity gradient stabilisation of UO-11 is the culmination of many months of preparation and many weeks of spacecraft activities — most of which has not been visible to the outside world! It has been very demanding and has necessitated the use of considerable facilities and required a particular, dedicated effort from the UoSAT Team — particularly Stephen (Attitude, Stabilisation & Navigation Analysis), Roger G8NEF (Spacecraft Software) and Neville G8NOB (Ground Station Software). A more detailed account of the Attitude Control and GG activities will be prepared in due course.

A day-by-day account follows:

Saturday 21/7/84

TORQUEH (the 1802 program which actively controls the magnetorquers in conjunction with reading the navigation magnetometer, records and replays whole orbit data and runs command timing loops) was further exercised as well as re-initialising its ODATA function at 21:29:40.

Sunday 22/7/84

TORQUEH was re-loaded following minor modifications. Yet further confirmations of spacecraft attitude taken!

Monday 23/7/84

Morning — Tests of final ground "deployment decision" software were made by switching the magnetometer on permanently and watching the fields changing. Residual oscillations of under 10 degrees were encouraging.

Evening — A full rehearsal of the boom deployment operation was run over 3 passes. The boom deployment commands were substituted by commands which were equally visible on the telemetry status points but otherwise harmless! After the ODATA was dumped, active magnetorquing was re-enabled.

Tuesday 24/7/84

Orbit 2112 — While holding the telemetry system in dwell mode (which prevents ODATA from recording since all channels are not found), the TORQUEH ODATA segment was reset, and active magnetorquing resumed. The spacecraft was left until LOS transmitting dwell telemetry to the ground analysis software.

Orbit 2113 — Sending one command told the 1802 to turn the z-magnetorquer on continuously, to allow the ground software to take a precise fix of the spacecraft attitude. After about 3 minutes of data, Stephen finally confirmed a suitable attitude, and the telemetry system was switched out of dwell mode to enable ODATA recording to start at 10:35:00 (approx). The channels recorded were 1,2,3,41,61,67. The last two record hexadecimal numbers — sorry if your ODATA program expired at this new facility!

At 10:35:20, a command to the 1802 turned the boom motor on for a 15.0 minute deployment and we watched the telemetry anxiously. An anomaly on the 5V current sensor prevented us seeing the true current, but the 14V bus was as expected and the motor was left running as the spacecraft disappeared below our horizon.

Orbit 2114 — Telemetry at AOS looked good, with the boom motor off and a good battery voltage. After taking the stored ODATA dump, the magnetorquers were disarmed and ODATA was reset at 12:19:23 to record channels 1,2,3, and 52. The real-time dump of the ODATA looked most encouraging.

By the evening, the next ODATA dump to be analysed confirmed a stable gravity gradient lock. More rapid dumps (always using channels 1,2,3,52) were made after resets at 18:37:53 and 20:09:45.

Wednesday 25/7/84

Another ODATA dump was initialised at 09:35:30.

The DSR was powered up on orbit 2127 and a CCD image taken. This was blank (following a day's analysis with hastily-assembled test equipment!) due either to incorrect pointing (we still have an unquantified amount of libration) or incorrect exposure. More experiments will be scheduled as soon as possible.

ODATA resets were initiated at 11:19:23 and 12:53:44 and 19:12:00.

Thursday 26/7/84

ODATA resets were at 10:12:00 (approx) and 11:58:18. Attempts to power up the sun sensors were partially successful due to a known problem with their current trips. During the evening, the

spacecraft was set to re-transmit audio from the 438 MHz uplink to test this uplink at the new attitude. Results were most encouraging.

Friday 27/7/84

The 2.48 Hz beacon was tested and found to be much improved in the new attitude. This downlink should prove to be very useful for engineering and high speed data for ground stations which are well-equipped with good receiving and decoding equipment.

UO-11 Mission Plan

Gravity gradient stabilisation marks the end of the major spacecraft commissioning phase of UO-11 and now allows us to progress with the commissioning of the experiments. This will commence with evaluation of the DCE and CCD Camera, however a more detailed Plan will be available shortly.

UoSAT-OSCAR 9 Schedule

The 2.4 GHz beacon will be in use this weekend.

Saturday — Bulletin/1200 bd telemetry/Digitalker

Sunday — Bulletin/1200 bd telemetry/Digitalker

Monday — Whole-orbit radiation data

Tuesday — Checksummed telemetry

Wednesday — CCD image

Thursday — Whole-orbit telemetry data

Friday — Load bulletin

Based on the response to our questionnaire, we are considering generating Digitalker for the educational 'market' on Mondays, now that we have started transmitting CCD images on Wednesdays. Radiation data will be scheduled occasionally.

General News — UoSAT Newsletters

The following information has been printed at UoS. The full pack has been sent to all enquirers who have written to us since February this year. It is available on request.

Newsletter — General status of UoSAT activities at June 1984

Datasheet 1 — UoSAT Project Summary

Datasheet 2 — UoSAT-1 Technical Data Summary

Datasheet 3 — UoSAT-1 Orbit Geometry, Tracking and Ground-station details

Datasheet 4 — UoSAT-1 Telemetry

Datasheet 5 — UoSAT-2 Project Summary

Datasheet 6 — UoSAT-2 Technical Description

Datasheet 7 — UoSAT-2 Reception, Data formats and Telemetry equations

Datasheet 8 — UoSAT-2 FSK demodulation using BBC Micro.

Questionnaire — As transmitted on this bulletin

Sheets describing the DSR data format and how to assemble this data to make up CCD images are under preparation as time allows.

Weather Satellite Status

- The NOAA-8 spacecraft is being decommissioned following a failure of the primary oscillator which commands the timing of the gyros and attitude control system. Engineers have not been able to switch over to the redundant oscillator as the primary oscillator has not yet failed completely.
- The NOAA-6 spacecraft has been re-activated to replace the failed NOAA-8 data.
- NOAA-7 will complete its planned operational lifetime this summer, but is continuing to perform well.
- The NOAA-9 spacecraft is currently scheduled for launch on 23 October 1984.
- METEOR-2-7 remains active on 137.3 MHz.
- METEOR-2-9 has not been heard recently.
- METEOR-2-8 is now active on 137.85 MHz.

Thanks for Reports & Questionnaire Returns

ZL1MO, G6AAL, IV3TKI, ZL1AOX, G3WDL/Kessingland VCP School, G4BZB, OZ1RO, HB9AYX, K1KSY, Sir William Turner's 6th Form College, G3TKW, G3UVC/Southampton C.H.E., Birger Lindholm, OZ1WN, G3FIJ, ON1BTH, JA2WO, HB9RJV/HB9RKR, PY2NKG, G3VOM, DD2OJ/DB2OS.

This week: PE1HLB, VK2ZYE, I2KBD, VK2RX, VK2XPW, VK2AVH, ON4HW.

Keplerian Orbital Elements from KA9Q.

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